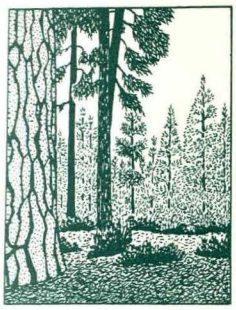

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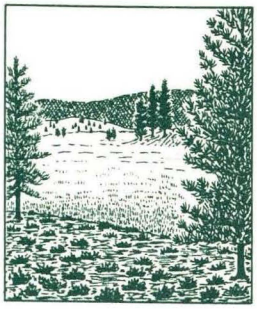

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SEEDING AND GRAZING TRIALS OF STIPA ON FOOTHILL RANGES

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Better grazing on California foothill range will accrue from plants which start growth earlier, produce more grazable herbage, stay green longer, and are less variable one year to another than are the resident annuals. Perennial grasses generally have part or all of these characteristics and consequently, have been tested frequently in improvement programs on annual-plant type range.

But the introduced perennial grasses that are the best forage plants do not compete well with the annuals under poor site conditions. For satisfactory production inland from the coast most of the introduced species require medium or fine textured soil about 2 feet deep, or deeper, and an average yearly precipitation of 20-25 inches or more if the soil is coarser in texture.[2]

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1/ Formerly range conservationist, California Forest and Range Experiment Station; present address: California State Polytechnic College, San Luis Obispo, California.

2/ Bentley, J. R., Lester J. Berry, Donald R. Cornelius, and R. Merton Love. Range species recommended for sowing on cleared brushland in California. U.S. Forest Service, Calif. Forest and Range Expt. Sta. Res. Note 111. 9 pp. 1956.

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Two species of a native perennial grass genus, Stipa, have survived and grown better than the introduced perennials on the marginal upland sites at the San Joaquin Experimental Range. The soil, of granitic origin, is sandy loam and generally shallow; precipitation averages about 19 inches a year.[3] Purple stipa (S. pulchra), also known as California needlegrass, and nodding stipa or nodding needlegrass (S. cernua), long considered a variety of purple stipa[4], are widely distributed in the California foothills. Purple stipa is best adapted in the coast ranges. Nodding stipa is the dominant species on relict areas in the vicinity of the experimental range. This paper reports seeding and grazing trials with these two species.

METHODS

The trials were made on two 1-acre areas of Vista sandy loam typical of the gently sloping, arable upland. The areas were prepared by cultivating during the winter just before sowing. The seed was drilled into firm seedbeds. In the first area the two species were sown February 2, 1946, in alternate rows 26 inches apart. In the second area the two species were mixed and drilled at 10 pounds per acre in 1-foot rows on February 27, 1950. The seed for the 1946 sowing was furnished by the Agronomy Department, University of California and for the 1950 sowing by the Soil Conservation Service.

Plants were counted periodically within a 2-foot-square frame which was laid down at 36 equally spaced grid locations in each seeding.

The plantings received two broadcast applications of single superphosphate fertilizer: 400 pounds per acre on December 12, 1951 and 375 pounds on September 27, 1953. Ammonium nitrate at 32 pounds of nitrogen per acre was applied to a 40-foot strip across the plantings on November 17, 1953.

RESULTS

The 1946 sowing produced a good stand. The plants were closely grazed by rabbits the first year and grew slowly the next 2 years. By the end of the 1948 growing season the plants averaged 2 inches basal diameter and 18 inches high. They made an impressive stand. In 1949 they were about 2 feet tall when annual species were about 6 inches. During the next 3 years when the stipa plants were ungrazed, they averaged 2-1/2 feet tall and the spreading seedstalks completely covered the space between rows.

3/ Talbot, M. W., J. W. Nelson, and R. E. Storie. The San Joaquin Experimental Range. The experimental area. Calif. Agr. Expt. Sta. Bul. 663:7-12. 1942.

4/ Love, R. Merton. Grass introduction and reseeding. Report to the State Board of Forestry, Davis, California, April 13, 1950.

The fair to good stand from the 1950 sowing also was grazed by rabbits to about a 1/2-inch stubble height and many seedlings did not survive the close grazing during the dry summer period. The scattered plants remaining grew well during the next 2 years, when they were about 2 to 2-1/2 feet tall and 2 inches in basal diameter.

The established stands were damaged by rodents but less so than most other perennial species. Gophers damaged the first planting in 1949 by tunneling along the rows and eating the plant crowns. In many places all plants were killed for distances of 1 or 2 to 6 or 8 feet. Some of the blank spaces had not filled with stipa by 1957. Occasional plants have been killed by gophers in other dry years.

Considerable seed was produced each year and in some years there were numerous seedlings, but density did not increase materially. Plant counts during 6 of the 8 years showed some variation in numbers of mature plants but indicated that numbers in the 1946 seeding increased between 1950 and 1953, then held rather uniform (table 1). In the 1950 seeding essentially the same plant density was maintained from 1953 through the latest count in 1957.

Table 1.--Numbers of stipa plants per average square foot

Date of count	1946 seeding				1950 seeding		
	Seedlings	One year	Two or more	Total except seedlings	One year	Two or more	Total except seedlings
4/14/50	9.60	0.15	0.41	0.56	--	--	--
8/6/52	0.10	0.20	0.27	0.47	0.25	0.16	0.41
6/9/53	0.50	0.55	0.49	1.04	0.03	0.25	0.28
5/15/54	1/	0.14	0.80	0.94	0.19	0.17	0.36
5/22/56	4.16	0.14	0.69	0.83	0.11	0.26	0.37
6/28/57	0.45	0.24	0.56	0.80	0.15	0.25	0.40

1/ Not counted.

The plants were divided into 3 age groups based on size: Seedlings, 1-year plants, and plants 2 years or older (table 1). This breakdown was not dependable however, because size of plant was influenced by competition from annuals and by grazing intensity. Where annual plants were dense, the stipa seedlings were usually hairlike and had 3 or 4 leaves at the end of a growing season; where competition was removed, as in the cultivated seedbeds, seedlings were as large as a lead pencil, had many leaves, and were a foot or more tall. Older plants were variable in size, especially after the stands were grazed.

Seedling numbers varied widely between years from a high of almost 10-per-square foot to a low of 0.1 plant per square foot. The greatest seedling count was in a year of good, but slightly below normal spring rainfall which followed a year of low rainfall. The second largest number of seedlings counted was in 1956, the year of greatest rainfall during the life of the plantings. The smallest seedling count was in 1952, the year of second largest rainfall.

GRAZING OF STIPA

The area sown in 1946 was grazed during early spring in 1948 to reduce the dense cover of broadleaf filaree and other annuals. At this season, when all of the vegetation was green, the cattle grazed more on the stipa plants than on the annuals, probably because of the greater height of leafage on the perennial grasses.

The area was next grazed for a month beginning September 28, 1951 as part of a 10.9-acre field. The available herbage was mainly dry annuals but included dry stipa and Hardinggrass and green pampasgrass plants. Leaves and small stems of Hardinggrass were eaten and the pampas-grass was lightly grazed throughout the month. Most of the annual plant herbage was consumed but no grazing of stipa was detected.

The low palatability of stipa after maturity was demonstrated again the following spring, after the seed had shattered but some greenness remained in the plants. Beginning May 20, 1952 the gates were opened and 5 cows, 3 calves, and 1 horse had access to the reseeded field. On June 5 numbers were increased to 20 cattle for 1 month. The cattle first grazed heaviest in the swale parts of the field, selecting the green rushes and then the partly green introduced annual legumes and Hardinggrass and the green pampasgrass. Finally the dry resident annuals and introduced legumes were grazed from among the stipa plants. The small stipa plants were eaten with the annuals but the mature stipa plants were rejected.

The palatability of stipa during the winter or fall and winter, was demonstrated in 1953 and each succeeding year. Three cows were put in the 10.9-acre field January 27, 1953 when new stipa leafage was 4 to 6 inches tall. Two days later part of this leafage was grazed on every plant. Hardinggrass had not been grazed but during the next few days it and most remaining stipa leafage was eaten. Grazing of stipa was continuous and almost to ground level in the next month except for a few large plants which contained old stubble. By mid-March stipa had recovered and was about 2 inches tall. Stipa was ignored throughout the rest of the spring when annual plant herbage was abundant and nutritious.

The field was grazed during fall and winter of the 1953-54 season--4 cows starting September 19 with an additional 1 at the end of October and 3 cows after January 5. They first grazed the dry annuals and small stipa plants. By November 5 all stipa plants less than about 1-inch diameter were grazed to a 1-inch stubble. Larger plants were partially grazed except for those with considerable old growth. Purple stipa was definitely selected at this time and was closely grazed. The nodding stipa was less palatable but by February all plants were grazed to a stubble height of less than 3 inches (fig. 1).

During the 3 succeeding years, 6 cows and calves part of the time were in the field from about July 1 to October 1 and had access to it and another field until February. Each year they started grazing the dry stipa plants, working first on the smaller plants but grazing all plants to about a 2-inch stubble height by midwinter or earlier.

Grazing reduced the size of stipa plants. Prior to grazing many plants were 4 to 6 inches in basal diameter. After several years of grazing the average was down to about 2 to 3 inches in basal diameter, with few larger.

Possibly contributing to the decrease in size of plants and to lack of increase in plant numbers is the fact that many plants or parts of plants were pulled by the grazing cattle. This loss was greatest during the fall grazing period and on the shallower soil. In November 1953 it was estimated that one plant or part of plant had been pulled on each 40 square feet of this driest site and lesser numbers on the better soil.

EFFECT OF FERTILIZATION

Application of single superphosphate produced no observable increase in growth of stipa plants, but growth of annuals, especially legumes, was greatly increased. Where nitrogen was applied, growth of annual grasses was stimulated but again no effect on stipa was noted.

Superphosphate fertilization may have increased stipa palatability. During September 1951 cows ignored the stipa while cleaning out annuals from among them. Every year after fertilizer was applied, the cattle ate the dry herbage during the summer and fall.

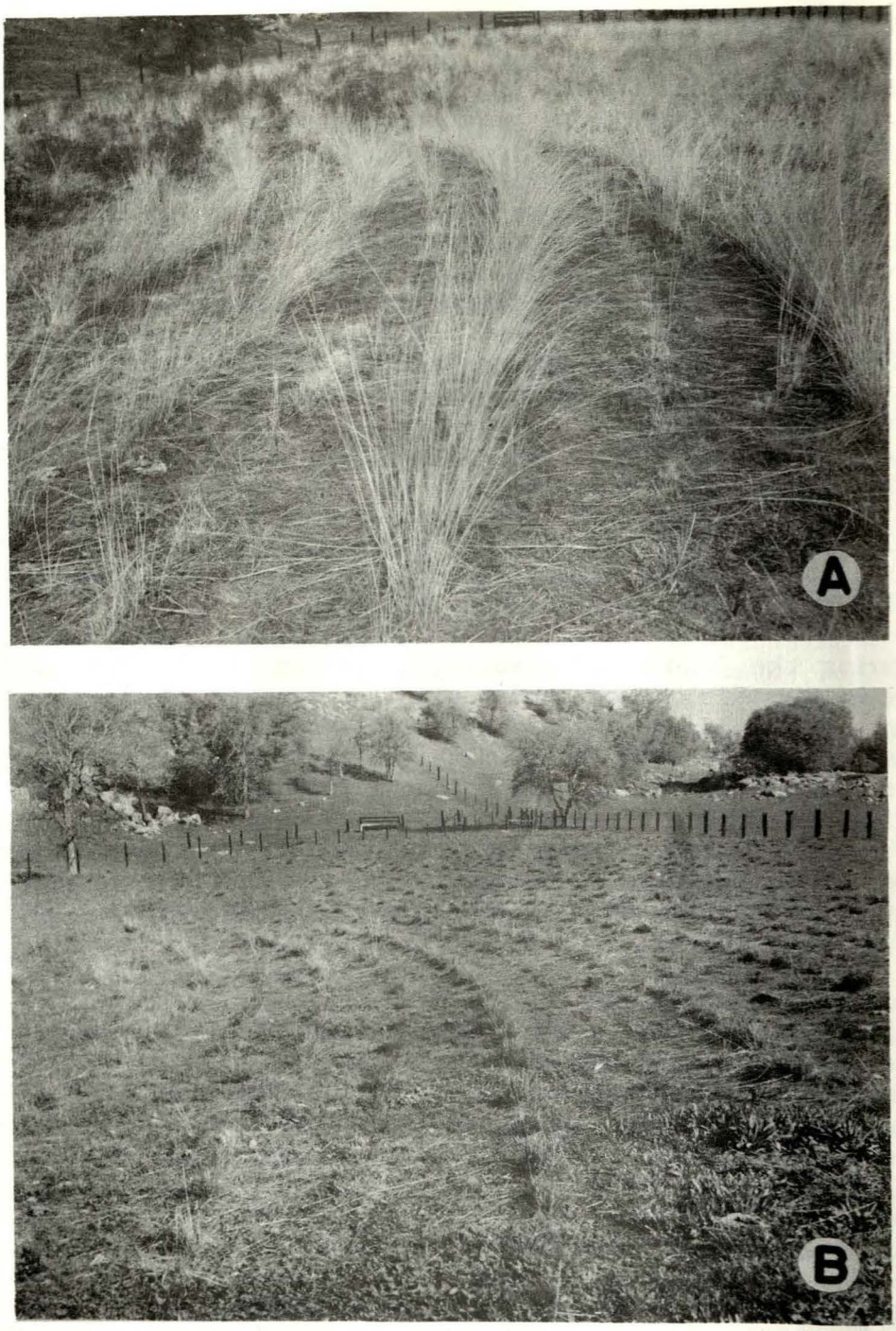

Figure 1.--A, Close grazing of purple stipa in the fall when alternate rows of nodding stipa were only slightly grazed, November 12, 1953. B, Uniform grazing of both species by late winter, February 24, 1954.

NODDING STIPA VS PURPLE STIPA

Nodding stipa, as compared with purple, showed more seedling vigor and had a greater survival so as to become more dense in the rows. Naturally seeded plants were preponderantly nodding stipa. In the years 1954-57 counts of each species showed that purple stipa plants made up only one-fourth to one-third of the total present in the area seeded in 1946.

Nodding stipa recovered from grazing more rapidly than the other but differences in degree of grazing may have been partly responsible for this. On April 21, 1953 nodding stipa, which had been closely grazed during the winter, averaged 14 inches tall; purple stipa was only half as tall and had fewer seed stalks and inflorescences. In 1954 cattle were removed from the pasture on March 11. On April 1 purple stipa plants were generally between 4 and 6 inches tall while nodding stipa was 6 to 8 inches.

Purple stipa was consistently favored by grazing livestock, and if either species was grazed, it was. This difference in palatability became evident when the area was first grazed. In November 1953, the first year the herbage was grazed when dry, an estimated 90 percent of available purple stipa was grazed and only 30 percent of the other species. All purple stipa was grazed to nearly ground level by December 31, but nodding stipa containing old stubble was not grazed.

HYBRID PLANTS

In the 1946 planting, 2 plants which may have been natural hybrid stood out as different because of much greater basal diameter, about 8 inches, and taller vegetative growth than any other stipa plants. These plants also tended to stay green later in the spring. No viable seed was collected from these plants, almost all lemmas were hollow, and those few which did contain a caryopsis always failed to germinate.

PLACE OF STIPA ON FOOTHILL RANGE

The trials showed that native stipa can readily be established and maintained on foothill range now having a dense cover of aggressive introduced annuals--a different cover than was present when stipa was abundant. The possibility of establishing stipa in such a cover once was a debatable point. Competition must be reduced before sowing; a clean seedbed is best but stipa seedlings will tolerate more weeds than most reseeded perennials.

For the borderline situation prevalent at the experimental range, stipa seemed the only perennial suited for broad-scale sowing on arable land. It produced usable winter herbage with no apparent competitive effect on growth of associated annual plants. Leafage of stipa was 4 to 6 inches tall during the winter when annuals were 1 to 2 inches in height and furnished little available forage (fig. 2).

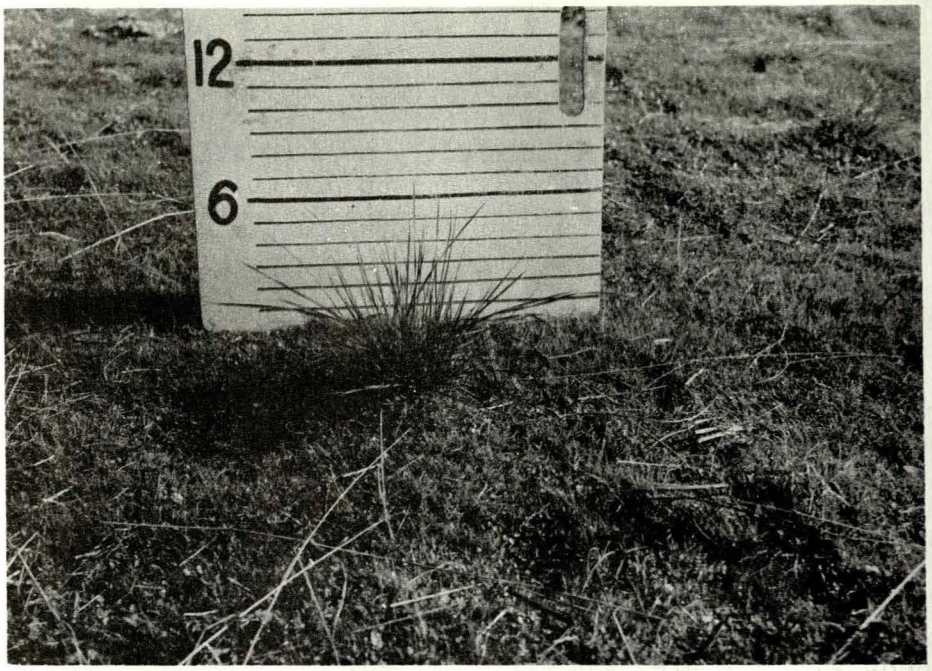

Figure 2.--Stipa plant protected from grazing was 4 to 6 inches tall when annuals were less than 1 inch, ~~June~~ Jan. 8, 1953.

The extra forage furnished by stipa is worthwhile during the winter when annual plants do not furnish enough volume to maintain livestock. A small additional amount of green forage has an important effect on livestock gains. Whether the production of extra stipa forage for winter use is economic will have to be determined by grazing trials. It appears to have little value for spring or summer grazing.

Stipa should be grazed during the winter when it is needed and is palatable. Apparently it will produce well if fairly closely grazed at this time of year, provided the plants are allowed to mature seed and restore root reserves during the spring. Continuous, heavy grazing through the year undoubtedly would eliminate stipa--and probably is a major reason for its disappearance from foothill range where it was once abundant.

Stipa has not been used in extensive foothill range improvement programs. One reason has been its low palatability and production when compared to the better perennials such as Hardinggrass. Another reason is its lack of response to increased soil fertility brought about by improved growth of legumes or by nitrogen fertilization. Its practical use is stymied by the lack of commercial seed sources. Attempts to produce and market the species have failed because of low demand and problems in production and harvest. It commonly produces light crops, much seed shatters before all of it is ripe, the seed is hard to harvest,

and the pointed callus makes the seed hard to handle after it has been deawned. In all, priority of stipa for sowing and grazing tests is low, but more work on seed production would be worthwhile because the species have a place where a perennial plant is needed on low value sites.

SUMMARY

Native stipa, purple and nodding, sown in a 2-acre area, competed with a dense cover of annuals better than introduced perennials on a borderline foothill site at the San Joaquin Experimental Range. Considerable viable seed was produced, but few of the numerous seedlings survived the dry summers. After the third year the number of established plants remained nearly constant. Cattle grazed stipa when turned into the field in late summer, fall, or winter. The small plants were taken first, but by mid-winter all plants were grazed to a low stubble. In the spring when green annuals were abundant and in the summer when a choice of good dry forage was available, the stipa was not grazed.

Purple stipa had less vigor and lower survival and was grazed more readily than nodding stipa but had slower recovery after grazing.

Stipa is valuable for fall and winter grazing. Its practical use in artificial reseeding is curtailed by lack of commercial seed and by other factors.